TENTH ANNUAL REPORT

OF

RUTGERS

Scientific School

THE STATE COLLEGE,

FOR THE BENEFIT OF

AGRICULTURE AND MECHANIC ARTS,

FOR THE YEAR 1874.

NEW BRUNSWICK, N. J.

TRENTON, N. J.:
PUBLIC OPINION—WM. S. SHARP, STEAM POWER BOOK AND JOB PRINTER.

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TRUSTEES' REPORT.

To His Excellency, Joel Parker, Governor of the State of New Jersey.

Sir:—I beg leave, in behalf of the Trustees of Rutgers College, to submit the Tenth Annual Report of Rutgers Scientific School, in accordance with the requirements of the act of Congress, approved July 2d, 1862, and of the act of the Legislature of the State of New Jersey, approved April 4th, 1864.

Since the date of our last report, the work of the institution has gone forward with very little change, though there has been, we are gratified to believe, a steadily increasing thoroughness, efficiency and success. No change has been made in the composition of the Faculty, except the retirement of Mr. James K. Barton from his position as Tutor of Mathematics, to engage in the active duties of his profession, as a Civil Engineer.

I. FACULTY OF RUTGERS SCIENTIFIC SCHOOL.

The Faculty is now constituted as follows:

Rev. Wm. H. Campbell, D. D. LL. D., President, and Professor of Moral Philosophy.

George H. Cook, Ph. D., LL. D., Vice President and Professor of Chemistry, Natural History and Agriculture.

David Murray, Ph. D., LL. D., Professor of Natural Philosophy and Astronomy.

Rev. Theodore S. Doolittle, D. D., Professor of Rhetoric, Logic and Mental Philosophy.

John C. Smock, A. M., Professor of Mining and Metallurgy.

George W. Atherton, A. M., Professor of History, Political Economy and Constitutional Law.

Rev. Carl Meyer, D. D., Professor of French and German.

Francis C. Van Dyck, A. M., Professor of Analytical Chemistry.

Edward A. Bowser, M. S., C. E., Professor of Mathematics and Engineering.

Isaac E. Hasbrouck, A. M., Adjunct Professor of Mathematics and Graphics.

Charles G. Rockwood, A. M., Ph. D., Professor of Natural Philosophy and Astronomy.

II. COURSES OF STUDY AND DEGREES.

The Courses of Study in the Scientific School have been arranged as follows:

1. A COURSE OF FOUR YEARS, IN CIVIL ENGINEERING AND MECHANICS.

2. A COURSE OF FOUR YEARS, IN CHEMISTRY AND AGRICULTURE.

3. A SPECIAL COURSE OF TWO YEARS, IN CHEMISTRY.

The special course in Chemistry is provided for the convenience of students who wish to devote themselves exclusively to that subject. Ample facilities are furnished them in the Laboratory and Lecture Room for the full employment of their time, and, on completing the course, they receive a certificate of a grade lower than the regular degree.

Provision is also made for PARTIAL STUDENTS, who may enter at any time, and elect, under the advice and direction of the Faculty, such studies as they may be found qualified to pursue, with classes already formed. Such students are subject to the general regulations and discipline of the Institution, are required to have their time fully occupied, and to pass such examination as may be prescribed in such case. On leaving, they receive certificates, stating the studies pursued, and the attainments made.

The two principal courses cover a period of four years each. The studies of the first two years are the same in both, and are arranged with special reference to the wants of young men who desire to become land surveyors, or to enter any department of skilled industry, but are unable to spend time to acquire a thorough educational preparation. Certificates are given to students who leave at the end of this short course.

At the end of the two years' course, students elect whether to pursue the course in Civil Engineering and Mechanics, or that in Chemistry and Agriculture, and for the remaining two years their studies are directed with particular reference to the choice made. Some studies, however, of a general nature, such as History, English Literature, Political Economy, Moral Philosophy, and others, are interspersed throughout the entire course, in order that students may receive a liberal at the same time with a technical education.

Students completing either of the four years' courses, receive the degree of Bachelor of Science (B. S.)

Graduates of three years' standing, receive the degree of Master of Science (M. S.) in course.

The degrees of Civil Engineer (C. E.) and Doctor of Philosophy, (Ph. D.) are conferred for distinguished professional success, or, on examination in prescribed subjects.

III. TERMS OF ADMISSION.

The conditions of admission to the regular courses of study remain the same as for the last three years.

Applicants must be sixteen years of age, and of good moral character, and, if coming from other institutions, must bring certificate of honorable dismission. They must pass a satisfactory examination in English Grammer and Spelling, Geography (descriptive), Physical Geography, History of the United States, Arithmetic, Algebra to Equations of the second degree, and Three Books of Plane Geometry.

The regular examinations for admission to the Freshman Class are held on Saturday and Monday preceding the annual commencement, and on the day before the opening of the fall term. Candidates for advanced standing are examined in the preparatory studies, and in those already pursued by the class which they propose to enter.

IV. STUDENTS AND STUDIES.

The classes now in the Institution are:

First. The Senior class, organized in September, 1871, which will be graduated in June, 1875.

Second. The Junior class, organized in September, 1872, which will be graduated in June, 1876.

Third. The Sophomore class, organized in September, 1873, which will be graduated in June, 1877.

Fourth. The Freshman class, organized in September, 1874, which will be graduated in June, 1878.

There was no graduating class in June, 1874, owing to the adoption of a four years' course of study in place of the three years' course, established when the Institution was organized. The present Senior class will, accordingly, be the first to graduate from the new course.

The Senior class now consists of eleven students; the Junior class, of six students; the Sophomore class, of twenty students; and the Freshman class, of eleven students; making a total of forty-eight now in attendance.

There have been in the Institution, during the year, sixty-two

students, of whom three were from Japan, one from England, one from the State of Alabama, one from the State of Connecticut, one from the State of Illinois, eleven from the State of New York, and the remaining forty-four from the State of New Jersey, representing thirteen counties, as follows:

Atlantic,	1
Essex,	3
Gloucester,	1
Hudson,	4
Hunterdon,	1
Middlesex,	19
Mercer,	1
Monmouth,	1
Morris,	2
Ocean,	1
Passaic,	1
Somerset,	2
Union,	7

It will be observed that these students represent nearly every section of the State; and it would be gratifying to the Trustees, if the friends of industrial education in counties that are not now represented, would interest themselves to see that their promising young men avail themselves of the free scholarships provided for them in the institution, in accordance with the law of the State.

The whole aim and tendency of the several courses of study are practical rather than professional. There has, as yet, been no demand among the students for manual labor on the farm. Nor is this regarded as the proper work of the institution. But every subject of study is taught with constant reference to the practical applications. In the study of Surveying, for example, students receive enough of field practice to make them entirely familiar with the use of instruments; while those who devote themselves to Agricultural Chemistry are not merely instructed in the principle of their science, but in the actual analysis of soils, fertilizers, &c. As a natural result of this system of training, our students, with scarcely an exception since the institution was organized, become employed in the various industrial pursuits of life, instead of entering the learned professions. But instead of being able to perform merely the labor of single individuals, as they would have been without mental discipline and acquirements, their education greatly multiplies their personal power, and makes them the natural leaders and organizers of industry. The experience of our graduates thus far fully justifies our best anticipations regarding them, and we are hopeful that the lengthening of the courses of study from three years to four will produce still better results in the same direction.

V. THE AGRICULTURAL DEPARTMENT.

The operations and present condition of the Agricultural Department are fully set forth in the accompanying report of Dr. Cook, the Professor of Agriculture. The College Farm, which was purchased by the trustees, as required by law, without expense to the State, and without any aid from the proceeds of the Congressional land grant, has hitherto been a heavy charge upon the funds of the institution. It is gratifying to report that it has now become self-sustaining, and promises to remain so, without any abridgment of the number and variety of important agricultural experiments. The experiments thus far carried on have attracted marked attention among the more intelligent farmers in this and other States, and they cannot fail to be increasingly useful, as year by year adds to the certainty and variety of their results.

VI. NEW CHAPEL, &C.

The Sophia Astley Kirkpatrick Memorial Chapel was dedicated December 3d, 1873, and has been in use ever since. The superior accommodations thus afforded for religious worship, and for the library, reading-room, &c., have greatly increased the working facilities of the institution. In conclusion, we would renew the expression of our desire and purpose to make the institution every year more useful, and more worthy of the friendly regard and support of all who have at heart the interest of a sound and liberal education.

The amount received from the State Treasurer for the fiscal year, ending October 31st, 1874, is six thousand nine hundred and sixty dollars ($6,960), which has been expended exclusively for the salaries of professors in the Scientific School. All of which is respectfully submitted.

WM. H. CAMPBELL,
President of the Board of Trustees.

New Brunswick, N. J., December 3d, 1874.

REPORT ON THE

FARM OF AGRICULTURAL COLLEGE.

BY GEORGE H. COOK.

The operations of the farm for the year 1874 have been confined to the raising of crops and stock, and some experiments on fertilizers. Up to this year, a large portion of the labor and expenses of the farm have been devoted to clearing the land of stumps and stones, to draining wet fields and patches of ground, so that it could all be tilled alike, and to enriching the soil, so that it would grow paying crops. It is with no little satisfaction that we report this work as now done. Thirty-five acres of new ground have been cleared of stumps, roots and stones, and cropped several times. Old hedgerows have been grubbed out, gullies filled, and roads made. More than seven miles of underdrains have been laid, and good dressings of farm-yard manure, or of commercial fertilizers, have been applied to all the fields. The care and responsibility of seeing these necessary but expensive preparations made, have been very burdensome; and, on account of the small returns obtained by the sale of farm produce while they were in progress, by no means easy to provide for. But the work is now completed, and the land ready for the production of paying crops. The business management of the farm is put in charge of Mr. Theodore West, a farmer of experience in this portion of the State; and he is beginning a course of farming in which he can apply those economies of labor and material and that judicious use of capital which are essential to profitable farming.

The establishment still needs a considerable outlay for buildings, fences, stock and implements, to put it in the best working order.

The season has been, as an average, rather unfavorable to good crops, or to conclusive experiments. The spring was wet and cold, so as to damage the early potato crop, and delay the time of corn

planting, and of course to prevent the thorough preparation of the ground. The cool weather and seasonable rains favored the grass and grain crops, so that our pasture and meadows were in the finest condition, and the growth was large and heavy; the wheat and rye were also very fine, and the oats, by getting a good start, were carried forward so as to be a fair average crop, though a little shortened by drought in its latter growth. We had almost continuous dry weather through July and August, so that carrots and mangolds were checked in their growth fully one-half; turnips and cabbage were held in check so long that there was not time left for their full development at the end of the season, and the ruta-bagas will not be a quarter crop. The corn crop is shortened in the grain from a quarter to a third, and in the stalks it falls short nearly half. The autumn weather has been unusually favorable for securing this year's crops, and for preparing the ground for those of next year.

Experiments.—The experiments with chloride of potassium upon Indian corn, given in the reports of 1872 and 1873, have been repeated this year. Twelve rows of corn were planted on a plot of unmanured ground of uniform quality, which measured eighty one-hundredths of an acre. After the corn was fairly up, six of the rows were dressed with chloride of potassium at the rate of one hundred pounds to the acre; the fertilizer being put directly on the hill. The other six rows were left without any manure. The chloride of potassium made the young corn wilt a little, and a few spears were killed; but most of it soon recovered and grew well. The stalks where the salt of potash was applied, have kept their green color best, during the whole season. The following are the weights of the ears of corn and the stalks, in pounds:

	Corn.	Stalks.
That manured with chloride of potassium,	1711	1420
That unmanured, - - -	1440	1232

The numbers showing the yield per acre in pounds, are inserted in the accompanying table, together with the amount of the crops per acre for the two preceding years, and the weight of the fertilizer used in pounds.

Years, - - - - - - - - - - - -	1872.	1873.	1874.
Corn in the ear, with muriate of potash,	5532	4109	4563
Corn in the ear, without " "	5505	4473	3840
Stalks, with muriate of potash, -	7104	4646	3787
Stalks, without " " - -	6000	3945	3312
Per centage of gain in weight of stalks,	18	18	15
Chloride of potassium, (muriate of potash,)	250	300	100

The experiment in 1872 showed no gain in corn, but a gain of eighteen per cent. in the weight of stalks. That of 1873 showed a loss in the corn, but a gain of eighteen per cent. in the weight of

stalks. The experiment of this year shows a gain of fifteen per cent. in the weight of the stalks, and of nearly the same amount in the corn. The crop of this year was grown in part on raw ground, and part on sod. That on raw ground was much damaged in the roots by an insect, but that manured with chloride of potassium suffered much less than that which was left unmanured. The extreme dry weather of the latter part of the season shortened the corn crop greatly.

These experiments tend to prove that chloride of potassium has a specific influence on the growth of *corn stalks*, and but little, if any, on the growth of the grain. It was accidental that the experiment with this fertilizer was first made upon Indian corn. A trial made for a different purpose, indicated that a marked effect was produced by it upon stalks, and this led to further trials for verifying or disproving the first result. This having now been done for two years in succession, and the results according with those of the first experiment, we shall now extend them to other graminaceous crops, in which the straw or hay is of more value than corn stalks. An experiment upon hay was begun this year, but the accuracy of the result was destroyed by a workman, and one upon potatoes was not satisfactory on account of the drouth.

An experiment has been tried of growing carrots upon the same plot of ground successive years. The cost of weeding and cleaning them is less than it would be upon new ground, for which reason we have raised them on the same plot now for four years,—manuring the soil with fifteen or twenty tons of barn yard manure each year. The carrots are much smaller, and less vigorous in foliage, and many more of them have been affected by the rot on the old ground, than those grown on adjoining ground which was broken up last year, and bears its first crop this season. The difference is so great that no one can avoid the conclusion that carrots, like other crops, thrive best on fresh soil, and that they cannot be grown year after year on the same ground with profit. We shall try another plot next season.

An experiment with turnips after oats, has shown that a most remarkable effect has been produced by the oats in unfitting the soil for growing turnips. The latter have not yielded a bulb worth gathering on the plot where the oats grew, while they are very thrifty on the ground all around these plots. The appearance of the crops is most surprising. The little plots where trial oats were grown are almost bare, while the surrounding soil is covered thick with turnip tops, and the exact line which bounds the plots, is as plain as if cut out by design. The experiment is suggestive as to the influence of the different crops upon those which succeed them, and the importance of a proper rotation of crops.

In fertilizers we have this season used in addition to farm yard manure, Mapes' Super-phosphate of Lime, Sternfel's Ammoniated

Dissolved Bone, The Manhattan Fertilizing Company's Blood Guano, Lister's Bone Meal, Peter Cooper's Bone Dust, Walton & Whann's Super-phosphate of Lime, Fish Guano, waste hair and lime. The extreme drought through part of July, August, and into September, interfered with conclusive experiments upon their effects. They are well prepared, and I have no doubt, in ordinary seasons, would have produced well marked effects.

VALUATION OF FERTILIZERS.

The value of commercial fertilizers is, by common consent, both in Europe and in America, calculated from their chemical components, which are ascertained by analysis. It is also allowed that ammonia, phosphoric acid and potash, are the only constituents, in a fertilizer costing $15.00 or upwards, per ton, that shall ordinarily be taken into account.

Experience has proved that these three substances are powerful fertilizers, and that they can be profitably used by farmers. The price per pound, at which each of them shall be rated, must be found from the lowest market rates of the commercial substances containing them. To establish prices for them, now, in the autumn of 1874, the following data may be taken as the basis, using the present wholesale prices in New York and Philadelphia.

Ammonia, can be got cheapest at the present time from sulphate of ammonia, which sells at five and a half cents per pound; or the equivalent of ammonia from nitrate of soda, which sells at three and three quarter cents a pound.

Commercial sulphate of ammonia contains from twenty-five to twenty-nine per cent. of ammonia. A sample analyzed here, contained twenty-five per cent. and we may use this for the standard. The twenty-five pounds of ammonia in one hundred pounds of sul. ammonia, are then worth $5.50, or twenty-two cents per pound.

Nitrate of soda, of ninety-six per cent. purity, contains the equivalent of nineteen per cent. of ammonia. And nineteen pounds of ammonia in the one hundred pounds of nitrate soda is worth $3.75, or almost twenty cents per pound.

As nitrate of soda is not so well known in our country as sulphate of ammonia, it is safest to adopt the price derived from the latter, which is twenty-two cents.

Phosphoric acid in its soluble form, is cheapest in some of the super-phosphates made from phosphatic guano, or mineral phosphates. Such super-phosphates guaranteed to contain eleven per cent. of soluble phosphoric acid, can be bought for $25.00 per ton. The ton contains, at this rate, two hundred and twenty pounds of the phosphoric acid. As two hundred and twenty pounds cost $25.00, one pound costs almost eleven and a half cents.

Phosphoric acid in its reverted form is only this acid changed from

the preceding; and is variable in quantity, and not intentionally for sale. As it is in the super-phosphates, and in many cases increases in quantity as the time they are kept lengthens, its price must be estimated from the experience of those who use it. Some farmers consider it quite equal to the soluble phosphoric acid; but it is usually considered to be a little less valuable. A price for it may be made at ten cents per pound.

Phosphoric acid in its insoluble form, as in animal bones, may have a price made out from the rates at which bone dust is sold. Bone dust, containing twenty-nine per cent. of phosphoric acid and two per cent. of ammonia, can be bought for $35 a ton. The two per cent. of ammonia amounts to forty pounds in the ton. This ammonia is still in its elements, and should not be estimated at above fifteen cents a pound, or the whole at $6, which would reduce the cost of the phosphoric acid in the bone dust to $29. The ton contains five hundred and eighty pounds of it, and of course, if five hundred and eighty pounds are worth $29, one pound is worth five cents. And this may be taken as the standard price.

Potash can be purchased in the form of muriate of potash, at the lowest rates. That salt of potash is now selling at $2.75 per hundred, at eighty per cent. purity. It contains fifty per cent. of potash, which, of course, must be considered as being worth $2.75, or five and one-half cents a pound.

PRICES.

Ammonia, per pound,	22	cents.
Soluble phosphoric acid,	11½	"
Reverted phosphoric acid,	10	"
Insoluble phosphoric acid,	5	"
Potash, (soluble),	5½	"

By the use of these prices, the value of any fertilizer of which an analysis is given can be calculated, remembering that the per centage of any constituent given in the analysis, if multiplied by twenty, will show the number of pounds of that constituent in a ton: thus the Guanape guano, given farther on, is estimated as follows:

	Analysis. Pounds.		
Ammonia,	11.61 × 20 = 232 @ 22	$51	04
Soluble phosphoric acid,	4.83 × 20 = 96 @ 11½	11	04
Reverted phosphoric acid,	7.00 × 20 = 140 @ 10	14	00
Insoluble phosphoric acid,	3.82 × 20 = 76 @ 5	3	80
Potash,	.90 × 20 = 18 @ 5½		90
		$80	78

The price at which this guano sells is $70 a ton.

The following named fertilizers have been analysed in our laboratory this year, as follows:

GUANAPE GUANO.

Ammonia,	11.61 per cent.
Soluble phosphoric acid,	4.83 "
Phosphoric acid soluble in neut. citrate of ammonia	7.00 "
Insoluble phosphoric acid,	3.82 "
Potash,	.90 "
Lime,	12.00 "
Sulphuric acid,	6.26 "

PHOSPHATIC GUANO, FROM LITTLE CURACOA.

Bone phosphate of lime,	62.22 per cent.
Carb. of lime,	19.62 "
Carb. of magnesia,	3.27 "
Sulphate of magnesia,	1.12 "
Common salt,	1.10 "
Insoluble matter,	.68 "
Water and organic matter,	11.60 "

It contains 28.51 per cent. phosphoric acid.

MAPES' SUPER-PHOSPHATE.

Phosphoric acid, soluble in water,	6.45 per cent.
" " " " citrate of ammonia,	1.42 "
" " insoluble,	5.44 "
Sulphuric acid,	16.84 "
Lime,	14.91 "
Ammonia,	3.40 "

WALTON AND WHANN'S SUPER-PHOSPHATE.

Phosphoric acid, soluble in water,	3.07 per cent.
" " insoluble,	7.62 "
Sulphuric acid,	14.06 "
Lime,	16.07 "
Ammonia,	3.29 "

MORO PHILIPS' SUPER-PHOSPHATE.

Phosphoric acid, soluble in water,	6.80 per cent.
" " insoluble,	13.18 "
Sulphuric acid,	21.54 "
Lime,	25.96 "
Potash,	.90 "
Ammonia,	.90 "

STERNFELS' AMMONIATED DISSOLVED BONE.

Phosphoric acid, soluble in water,	3.84 per cent.
" " insoluble,	1.53 "
Ammonia,	1.70 "

TEXAS BONE MEAL.

Bone phosphate of lime,	42.41 per cent.
Carbonate of lime,	6.18 "
Animal matter,	38.50 "
Insoluble matter, mostly sand,	11.50 "

It contains

Phosphoric acid, 21.00 per cent.
Ammonia, 3.63 "

FISH GUANO, (TUCKERTON).

Phosphoric acid, insoluble,	4.02 per cent.
" " soluble in water,	.47 "
Ammonia,	4.80 "
Potash,	.29 "
Water,	51.24 "

FISH GUANO, (WALTON AND WHANN).

Phosphoric acid, insoluble in water,	4.09 per cent.
Ammonia,	5.05 "
Potash,	2.40 "
Common salt,	29.50 "
Water,	10.53 "

SULPHATE OF LIME, FROM RANCOCUS PHOSPHORUS WORKS.

Lime,	33.04 per cent.
Sulphuric acid,	42.23 "
Phosphoric acid,	4.10 "
Insoluble matter, (sand, etc.),	4.50 "
Water,	.16 "

CHLORIDE OF POTASSIUM.

Potassium chloride,	86.98 per cent.
Common salt,	12.62 "

SUGAR-HOUSE SCUM.

Organic matter,	42.2 per cent.
Ash,	7.8 "
Water,	50.0 "

The organic matter yields 2.5 per cent. of ammonia.

LEACHED WOOD ASHES, FROM CANADA.

Water,		39.00 per cent.
Soluble in water.		
Potash,	.30	
Chlorine,	.18	
Sulphuric acid,	.28	
Lime,	.26	
	— 1.02	"
Soluble in acids.		
Potash,	.46	
Lime,	28.43	
Magnesia,	2.73	
Carbonic acid,	19.70	
Phosphoric acid,	1.82	
	—53.14	"
Insoluble in acids,	6.50	"
	99.66	"

CROPS.

The crops raised this year have been as follows:

Wheat has been grown on two and seventy-one one-hundredths acres of the old land near the barn, and on nine and one-quarter acres of new ground. That on the new ground was light; the surface of the field is so flat that the water gets off it with extreme slowness; and the fall in the tile drains is so little that tile of the ordinary size cannot carry off the water quick enough, and the wheat was damaged. The smaller plot grew well and produced a fine crop. The land was in potatoes last year, and was well manured for that crop with barn-yard manure. The variety grown was Fultz wheat, and the whole crop was ninety-nine bushels, or thirty-six and one-half bushels per acre. The crop is a good one, much better than can be grown after oats, and the result is suggestive as to the improvements which may be made by the selection of a proper crop to precede the wheat, and by enriching the ground beforehand, so that no barn-yard manure need be used on the grain. Our crop stood up well. The Fultz is of better quality than the common Mediterranean wheat; it has a shorter and stiffer straw, and the yield of grain is larger.

Rye.—The plot of this grain sown for a fodder crop was allowed to ripen. There was only a half acre of it, and that was partly on poor ground, so that while some was quite as good as last year, other parts were light. The yield was twenty-five bushels an acre. This crop is an excellent one for supplying the earliest green fodder—that is, from the 15th of May to the 15th of June—in great quantity, or, if it is not needed for that purpose, it will ripen and yield a valuable crop of grain and straw. It costs but little labor, and we shall gradually increase the size of the plot appropriated to it and to sowed corn.

Oats.—Six and three-quarter acres of good oats were raised on ground that was to be sowed with wheat and grass seed. This crop is raised because it comes conveniently in the succession between corn and wheat, and costs but little labor. But it is a damage to the crop which is to follow, and if the corn ground were rich enough to grow paying crops of potatoes, peas or beans, it would be more profitable to raise them.

Indian corn was grown on thirteen and one half acres of ground, partly sod and the remainder corn ground last year. It was the poorest ground on the farm, and the crop was light, eleven or twelve hundred bushels of ears of corn. That on the sod was by far the best.

Hay was taken from about thirty acres, and ninety two-horse loads were taken into our barns. This crop is peculiarly well adapted to our soil.

Potatoes were grown on about three and one half acres of ground, most of the Early Rose variety. Barnyard manure was applied

freely on the ground before planting, and the best of tillage was employed, but the growth was very moderate, not more than one hundred bushels to an acre. The soil on our farm is not naturally adapted to growing potatoes, and if we succeed in raising them successfully at all, it will be after a series of careful experiments have been made with different fertilizers and modes of culture.

Carrots were planted on three and one half acres, and our crop is about eight hundred and fifty bushels. We grow this crop largely because we are in the borders of a large town, and near to market, and the carrots find a ready sale to those who feed them to horses. They have a very salutary effect on the condition of the animals fed with them, and we find that those who have once fed them invariably come for more. They are an expensive and troublesome crop to raise, requiring a richly manured soil, and a great deal of hand labor to keep them clean and well tilled. Our greatest trouble is to get the young carrots to start. They are the weakest of plants, and if any crust forms on the surface of the ground a single plant has not strength to break through, but perishes under it. If planted several seeds in one place they are much more likely to come up and stand evenly.

Mangold Wurzels were grown on something more than three acres of ground. Our crop was but light, the dry weather almost killing the plants. About twelve hundred bushels have been harvested. This crop requires rich ground, but it is not near so troublesome to thin and weed out as that of the carrot. We grow them for supplying cow feed in the latter part of winter and in spring. They keep with very little care, and are in good condition when turnips, rutabagas, and carrots are spoiled by sprouting or rot.

Cabbage and rutabagas.—We have about four acres of each of these, but the dry weather has spoiled at least half of the cabbage crop, and three quarters of the rutabagas. They are ordinarily reliable market crops, and we have received a considerable income from them.

Fodder corn.—We have raised good crops of sowed corn every year, by sowing it broadcast, about three bushels of seed per acre. And each year we are more and more convinced of its usefulness as one of the staple farm crops. It needs very rich ground, and it does not get to its best condition until kernels are well formed in the ears. We cure whatever we have left from the summer's use, by cutting and setting it up in small shocks, in the same way we set up our field-corn.

Stock—The work of the farm is done by horses and mules, one pair of each. Fourteen cows are kept, the milk from which is sold in town. In changing the farm management this year, we have failed to keep the record of milk from each cow as heretofore, but shall keep it again next year. Our finest cows are Ayrshires, though the difference between them and first-rate native and grade cattle is not very

great. We hope to make some experiments on feeding with different kinds of cattle food the coming year.

Implements.—We have added but little to our implements the past year. *Allen's wheel hoe* we have found a valuable labor-saving implement in cleaning and cultivating our root crops. We have added a new horse-power and thresher from the establishment of B. Gill and Son, of Trenton, and are well satisfied with them. Our own workmen do our threshing at the times which suit the other work; and our horse-power is much used to drive a stalk-cutter with which we cut up most of our corn stalks.

Donations.—From Walton, Whann & Co., Wilmington, Del., one thousand pounds super-phosphate of lime, and seven hundred and fifty pounds fish guano.

From Hon. F. S. Holcomb, Lambertville, N. J., two bushels of seed-corn in the ear.

The operations of the farm are open for inspection at all reasonable times, and Mr. West, the manager, is ready to show visitors about the place. The Professor of Agriculture will be glad to meet visitors, farmers, or committees, at the farm, by appointment, on any Wednesday.

The inquiries which are made by the visitors to the farm, are bringing out the points in farming which are of most interest to practical farmers, and, in this way, showing what the work at the farm should supply. Constant inquiries are made for information about the value and action of the various home-made or commercial fertilizers. Inquiries are also made as to what rotation of crops will best draw out all the fertilizing matters put on the soil. Much interest is expressed in regard to new or improved varieties of seeds and crops. The comparative value of different breeds of domestic animals, is an object of much interest. The feed for stock which is most profitable for producing milk or meat, is also inquired for with much earnestness. These, with many other points of detail, are the subjects of inquiry continually, and they must be answered.

The farm should be made an *experiment station*, where a competent chemist, with assistants, may be permanently employed in the analysis of fertilizers, and the investigation of matters of agricultural interest. Here should be conducted those experiments on subjects of rural economy, which require accurate records of weight, measure, and time. The appliances and means should here be provided to pursue such inquiries, without depending on their immediate profit for meeting the expenses necessarily incurred in their prosecution.

Experiment stations of this sort have succeeded wonderfully in foreign countries, and new ones are being established every year. They are popular with the people, and are exerting a marked influence

on the agriculture of the countries where they are located. We need one in New Jersey. The Agricultural College is the place for it, and it would be a wise act for the State to provide the means for setting it in practical operation at once.

Agricultural College, New Brunswick, N. J.,
December 1st, 1874.

COURSES OF STUDY

IN

RUTGERS SCIENTIFIC SCHOOL.

Three distinct courses of study are included in the Schedule which follows:

I. A Course in Civil Engineering and Mechanics.

II. A Course in Chemistry and Agriculture.

III. A Special Course in Chemistry.

During the first and second years the studies of the two full courses are the same, and are designed to furnish a suitable introduction to the pursuit of the higher branches in either.

During the last two years the subjects of Higher Mathematics, Mechanics and Engineering in the Engineering course, are replaced by Analytical Chemistry, practice in the Laboratory, and Agriculture in the second course. The remaining subjects are pursued by the students of both courses together.

The course of study for the first two years in this Department is arranged so as to be complete in itself. It is especially designed to meet the wants of those who cannot take the entire four years' course, but who desire to fit themselves as Land Surveyors. Students leaving at this period of the course, receive from the faculty a certificate of their attainments.

Special Students are received, and allowed to take any part of the above course; and particular provision is made for them, especially in the Laboratory, in Mathematics and Surveying.

The Special Course in Chemistry and Agriculture, occupying two years, is designed for those who wish to devote themselves exclusively to these branches. Opportunities of a very superior character are afforded to such students under the charge of Professors Cook, Smock, and Van Dyck, in the new Laboratory building.

Special provision is also made for students who desire, after completing the regular course of study, to take post-graduate studies.

COURSE OF STUDY.

FRESHMAN YEAR.

Exercises during the year in Composition and Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. French. 2. Mathematics—Loomis' Algebra, from Quadratic Equations. 3. Natural History—Dalton's Physiology; Lectures. 4. Rhetoric—Haven; Lectures. 5. Draughting—Construction of Problems.

SECOND TERM.

1. French. 2. Mathematics—Loomis' Geometry, from Book IV. 3. Natural History—Zoology; Lectures. 4. Elocution—Lectures. 5. English Literature—Shaw's Manual; Craik's English of Shakspeare. 6. Draughting.

THIRD TERM.

1. French. 2. Mathematics—Loomis' Trigonometry, Plane and Spherical. 3. Natural History—Gray's Botany; Lectures. 4. English Literature—Shaw's Manual; Lectures. 5. Draughting.

SOPHOMORE YEAR.

Exercises during the year in Composition and Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. Surveying—Murray's Manual; Field Exercises and Mapping. 2. Descriptive Geometry—Church. 3. Chemistry—Lectures. 4. Mental Philosophy—Haven. 5. History—Freeman's Outlines.

SECOND TERM.

1. Descriptive Geometry—Church; Construction of Problems. 2. Chemistry—Lectures. 3. Mental Philosophy—Haven. 4. History—Freeman's Outlines.

THIRD TERM.

1. Leveling and Railroad Curves—Henck's Field Book; Field Practice and Plotting. 2. Shades, Shadows, and Perspective—Church; Construction of Problems. 3. Chemistry—Lectures. 4. Mental Philosophy—Lectures. 5. History—Creasy's Constitutional History of England.

JUNIOR YEAR.

Course in Civil Engineering and Mechanics.

Exercises during the year in Composition and Original Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. German. 2. Analytical Geometry—Peck. 3. Natural Philosophy—Snell's Olmsted. 4. History of Civilization—Guizot. 5. Constitutional History of the United States—Text-book and Lectures. 6. Draughting.

SECOND TERM.

1. German. 2. Differential and Integral Calculus—Peck. 3. Natural Philosophy—Snell's Olmsted. 4. Political Economy—Bowen and Perry. 5. Constitutional History of the United States—Text-book and Lectures. 6. Draughting.

THIRD TERM.

1. German. 2. Mechanics—Bartlett, or Smith. 3. Astronomy—Loomis. 4. International Law—Woolsey. 5. Draughting.

JUNIOR YEAR.

Course in Chemistry and Agriculture.

Exercises during the year in Composition and Original Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. German. 2. Mineralogy and Analytical Chemistry—Text-book, with Laboratory Practice. 3. Agriculture—Lectures at the Farm. 4. Natural Philosophy—Snell's Olmsted. 5. History of Civilization—Guizot. 6. Constitutional History of the United States—Text-book and Lectures.

SECOND TERM.

1. German. 2. Analytical Chemistry—Text-book, with Laboratory Practice. 3. Agriculture—Lectures. 4. Natural Philosophy—Snell's Olmsted. 5. Political Economy—Bowen and Perry. 6. Constitutional History of the United States—Text-book and Lectures.

THIRD TERM.

1. German. 2. Analytical Chemistry—Text-book, with Laboratory Practice. 3. Agriculture—Vegetable Physiology. 4. International Law—Woolsey.

SENIOR YEAR.

Course in Civil Engineering and Mechanics.

Exercises during the year in Composition and Original Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. Mechanics—Bartlett, or Smith. 2. Geodesy—Theory and

Practice of Triangulation 3. Chemistry—Lectures on Organic Chemistry. 4. Moral Philosophy—Wayland and Hopkins.

SECOND TERM.

1. Engineering—Mahan. 2. Geodesy—Practical Astronomy; Indeterminate Analysis. 3. Chemistry—Lectures on Chemical Physics. 4. Moral Philosophy—Butler's Analogy.

THIRD TERM.

1. Engineering—Bridge-Building and Railway Practice. 2. Architecture—Lectures. 3. Geology—Lectures; Geological Excursion. 4. Moral Philosophy—Butler's Analogy.

SENIOR YEAR.

Course in Chemistry and Agriculture.

Exercises during the year in Composition and Original Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. Mining and Metallurgy. 2. Chemistry and Principles of Agriculture—Lectures. 3. Laboratory Practice. 4. Moral Philosophy—Wayland and Hopkins.

SECOND TERM.

1. Agriculture—Its Methods and Products. 2. Chemistry—Lectures on Chemical Physics. 3. Laboratory Practice. 4. Moral Philosophy—Butler's Analogy.

THIRD TERM.

1. Agriculture—Animal Physiology; Care and Management of Domestic Animals. 2. Architecture—Lectures. 3. Geology—Lectures; Geological Excursion. 4. Moral Philosophy—Butler's Analogy.

SPECIAL COURSE IN CHEMISTRY.

FIRST YEAR—FIRST TERM.

1. Elements of Chemistry—Text Book and Lectures. 2. Blowpe Analysis. 3. Elements of Mineralogy.

SECOND TERM.

1. Physics and Chemistry—Text Book and Lectures. 2. Chemical Analysis—Qualitative.

THIRD TERM.

1. Chemical Analysis—Qualitative and Quantitative. 2. Vegetable Physiology.

SECOND YEAR—FIRST TERM.

1. Chemical Analysis—Analysis of Minerals, Ores, &c. 2. Mineralogy—Determinative.

SECOND TERM.

1. Chemical Physics—Heat, Electricity, Magnetism, Galvanism, and Electro-magnetism—Text book and Lectures. 2. Analysis of Fertilizers and Chemical Products.

THIRD TERM.

1. Lectures on Geology. 2. Chemical Analysis—Special Investigations.

REPORT OF THE BOARD OF VISITORS.

To His Excellency, Joel Parker, Governor of the State of New Jersey:

Sir:—The Board of Visitors of the New Jersey State College for Agriculture and Mechanic Arts, beg leave to present their tenth annual report:

Since our last report two semi-annual meetings have been held by this Board at the college buildings at New Brunswick, as required by law; we also, at the June meeting, appointed a committee, consisting of ex-Governor Newell and Judge Wm. McIlvaine, to visit the college farm, and to make a report at the next meeting of the Board, to be held in December.

The first of our meetings was held December 23d, 1873. The second was held June 12th, 1874. At each of these meetings the Board attended and heard the various classes examined by their instructors, (the professors of the college), in the subjects of study for the past year. Owing to the change in the course of instruction from a term of three years to a period of four years, this year there was no senior or graduating class.

The subjects of study upon which the students were examined were substantially the same as the classes in the corresponding grades and terms were examined upon last year, as more particularly enumerated in our last annual report.

At our meeting in December, the President of the College, Rev. Dr. Wm. H. Campbell, informed the Board that Professor Charles G. Rockwood, of Bowdoin College, had been chosen by the Trustees, and had accepted the position of Professor of Natural Philosophy and Astronomy, and would enter upon his duties in January.

The college buildings, Geological Hall, and the Sophia Astley Kirkpatrick Memorial Chapel were inspected. The last named new building is used as a chapel and library, and was constructed from funds bequeathed to the college by Mrs. Sophia Astley Kirkpatrick. It is a stone structure and is a beautiful specimen of architecture. All of the buildings were in excellent condition.

At both of our meetings resolutions were passed approving the proficiency of the students as evinced in their examinations, and commending the officers of the institution.

It is our duty to inform Your Excellency that the terms for which two members of the Board of Visitors were appointed, namely, Hon. Joseph Thompson, of Readington, in the Fourth Congressional District, and of Rev. John Steele, D. D., of Paterson, in the Fifth Congressional District, will expire April the 12th, 1875.

All of which is respectfully submitted.

WILLIAM PARRY,
President.

HENRY K. HOW,
Secretary.

REPORT OF

COMMITTEE OF BOARD OF VISITORS

ON FARM OF AGRICULTURAL COLLEGE.

The deputation from the State Board of Visitors of the Rutgers Scientific School, appointed to visit and inspect the farm connected with that Institution, respectfully reports, that the designated duty was discharged in the month of June when the crops were growing, and again in October, when they were matured and mainly gathered. It gives the committee pleasure to inform the Board that the farm is in excellent condition, highly improved and cultivated, and capable of producing abundantly. The waste land, which a few years since constituted a considerable portion of the farm, has been thoroughly reclaimed by clearing and under-draining, so that at the present time the entire enclosure is under successful and profitable tillage. Grass and the winter grains yielded largely, but the later crops, corn and the various vegetables, were seriously reduced by the protracted drouth which prevailed in that locality.

The stock is in good condition, and is treated with gentleness and care, indeed the management of this department will reflect credit upon any of the established stock farms of the country.

The buildings are well preserved, but are not adapted to the improved condition of the soil, neither in capacity nor construction, and the fences require a better adaptation to grazing the stock, and preventing depredation.

The trustees, however, are not responsible for this deficiency, as it is understood that there are no funds which can be appropriated to these purposes without impairing the efficiency of the system of improvement and experiments adopted, and which promises such great success.

The experiments testing the relative value of the various fertilizers now in use, constitute a most interesting and valuable part of the operations. Plans are in preparation for an annual series of these trials with ammonia, potash, and the phosphates, and we may confidently anticipate the most important results from them to the

great agricultural interests which constitute so essential a feature of our national prosperity. We regard this plantation as a model farm, and commend an inspection of its operations to all persons who desire to obtain useful information in this department of labor and knowledge.

We also recognize the ability and fidelity with which the Trustees of Rutgers College, and the distinguished Professor of Agriculture and State Geologist, Dr. Cook, who superintends the agricultural department of the Rutgers Scientific School-farm, discharged the trust confided to their care by the State of New Jersey.

WILLIAM A. NEWELL,
WM. R. McILVAINE, } *Committee.*

December, 1874.

A FURTHER SUPPLEMENT to the act entitled, "An ac tappropriating scrip for the public lands granted to the State of New Jersey by the act of Congress, approved July second, one thousand eight hundred and sixty-two;" approved April fourth, one thousand eight hundred and sixty-four.

1. Be it enacted by the Senate and General Assembly of the State of New Jersey, That the term of office of members of the board of visitors to the Agricultural College of New Jersey, shall hereafter be two years; *provided*, that this provision shall not apply to members appointed previous to the passage of this supplement.

2. And be it enacted, That the actual personal expenses of members of the board of visitors, incurred in the discharge of the duties imposed upon them by the act to which this is a supplement, shall be audited by the comptroller and paid by the treasurer of the state, out of any moneys unappropriated, on the certificate of the president and secretary of the board.

3. And be it enacted, That this act shall take effect immediately.

Approved March 26th, 1873.

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